

Overcoming the Limitations of Proprietary Computerized Billing Systems to Enhance Patient Care

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Most physician offices have proprietary computerized billing systems, but these are not designed for monitoring utilization or addressing patient care issues, and they are difficult or impossible to modify. These systems do, however, contain valuable diagnosis and demographic information. An open-ended, relational x-base system is described that downloads this billing information and combines it with additional input to provide the practitioner with: current problem lists; medication and allergy lists; health screening reminders that are age, sex and disease specific; and commonly used demographic information. Several popular query/reporting tools are used to generate standard reports and ad hoc inquiries that relate directly to patient care. Two studies, one involving alerting physicians to possible adverse medication effects on specific patients, and one investigating appropriate use and billing of stool occult blood testing are summarized. In the constantly evolving arenas of utilization, outcomes research and cost efficiency, such an open ended, time efficient system has unlimited potential to improve patient care.

INTRODUCTION

The past decade has seen a health industry paradigm shift from disease to wellness, with many barriers to success that center around the availability, interpretation and utilization of clinical information.¹ Patient care based computer systems have been shown to have a positive effect on patient health and well being,^{2,3} but most medical practices have, at best, a proprietary computerized system that deals only with billing and finances and is not easily modified.

Many clinical information systems were designed for large volume transaction processing. The major transactions that are processed are patient registrations and arrivals and patient appointment scheduling as well as some clinical information like diagnosis and performed procedures for billing purposes. This information is usually adequate for the business end of running a clinic, but provides very little information for a clinician.

Another drawback of current centralized clinic data is access. Inquiries require specialized programming knowledge. This often necessitates that only a few people know how to access the information. These "super users" become the bottle-neck to information retrieval due to the many requests for information that exist in an academic medical center, or the lack of such capabilities in the average private practice. Training end users to manipulate the system seems like a viable alternative until it is investigated further. One issue is the training time. Many legacy systems use data access languages that are not user friendly, i.e. require programming, and the data itself may not be stored in a format that is readily understood by an end user. This creates a high learning curve for an end user. Another drawback of turning end users loose on an enterprise-wide system is system resource consumption. Querying information uses a lot of computer processing time. It does not take a complex query to bring a system to its knees. If this happens during a peak operating time in the clinics, patients being registered for clinic visits may be unnecessarily delayed while the query is processing. This is not acceptable in most current clinic environments.

There is a paucity of information systems that deal with enhancing patient care and cost effectiveness, and there are few inducements for physicians to spend the time and money to use these "additional" systems. Medical practices in West Virginia are typical examples of this, with multiple proprietary billing systems, little networking, and virtually no information systems that directly benefit the patient.⁴

One solution used by the Department of Family Medicine is the creation of a distributed data warehouse. The data warehouse answer takes all of the Family Medicine transaction data from the mainframe and stores it locally in the department on a LAN based PC. The program that was developed takes the data and converts it into a relational format. By storing data in a relational format, end users have the option of using many of the off the shelf query and reporting tools that are available commercially.

A benefit of creating a distributed data warehouse is optimal system performance. Queries that were once a special request on the mainframe are now done off-line. This has benefits for both the end user as well as to computer operators in the computer systems department. For the end user it means faster turn-around time for information and more freedom to experiment with the data in an *ad hoc* manner. This can lead to a more empowered knowledge worker and also enhance their decision making ability. For the computer operations department it means less time generating reports for end users and more time for software maintenance and updates. It also means that the mainframe system can be dedicated more to transaction processing during peak clinic times than to data retrieval.

METHODS

System Features

In addition to information imported from the mainframe, the Family Medicine system was also enhanced to provide a Mini Electronic Medical Record (MEMR), which is printed at each patient visit and acts as a worksheet to update the database. This is used to augment patient care in the daily operation of the clinic. From the mainframe data we are able to obtain the patient demographics and the patients diagnoses and procedures performed each visit. From this data we generate two additional lists for a patient. A health screenings list and a patient problems list, both part of the printed MEMR. The health screenings list is created automatically for each patient based on the patient characteristics of age and sex. This list serves as a reminder to the physician of what screenings this patient has had, has not had, or what is pending. This health screening database is capable of being modified to individual patient needs, such as the diabetic that needs a quarterly glycosylated hemoglobin. The problem list provides a list of active diagnoses for each patient.

Another enhancement to the system was the addition of current patient medications on the MEMR and access to a medication history. This makes it very easy for the physician to, for example, see which blood pressure medications have been prescribed in the past in order to avoid repeating a regime that has already been tried.

Standard reports not requiring *ad hoc* inquiry include diagnosis and procedures by physician or clinic, age and sex distribution, and patient lists by provider. These can be generated for any period of time. Since the Department of Family Medicine consists of over 40 faculty and residents, these reports are helpful in reassigning patients and checking on the consistency of the educational experience.

System Description

The data warehousing program and user front end was developed using a language called CA-Clipper™. This is a popular x-base language that can store and access data in many of the popular PC and mainframe data formats. CA-Clipper™ was chosen for its superior transaction speed, and ability to handle transactions in a multi-user environment.

The .dbf data format was chosen for the Family Medicine department data. This format allows access to the data from many popular query/reporting tools. The data access tools currently being used in the department are R&R Report Writer™ for both Windows™ and DOS™, and the FoxPro™ report writer.

Departmental expenses for the first year of operation of the system amounted to approximately \$7,500. Expenses included: software development, installation, training, on-line help system development, technical documentation, and all enhancements made in the first year. On-going maintenance for the MEMR system is estimated to be \$600 per year. Multiple sites may eventually use this system, which will further decrease the cost of development.

The bulk of the information is easily imported from the mainframe in a periodic batch process. With 3,000 monthly clinic visits, this is the most lengthy function of the system, but is done automatically at night. The current medication and health screening information is updated from provider-completed worksheets that are included with every patient visit. Entry of this information into the database is done daily and requires an approximate 0.3 FTE commitment for 36,000 annual visits.

System Performance

Patients can be looked up by name, hospital number, birth date, Social Security number, and family identifier. Each search takes less than one second even with some files containing over 200,000 records. Most complex queries take less than 10 minutes to run for department wide data on a 486 66MHz PC based system. On-line help has gained wide user acceptance.

Patient Benefits and Outcomes Research

To date, two large *ad hoc* inquiries utilizing only the information available on the system have been done that have had a direct impact on patient care and clinic cost utilization. In addition, we have monitored the acceptance of the system and the minimal extra effort required to fill out the database update worksheets (Mini Electronic Medical Record) as reflected by user participation.

Possible Adverse Medication Effects. Diabetes mellitus, hypertension, hyperlipidemia and atherosclerotic heart disease often go hand-in-hand. There are certain classes of medications that while useful for one of these health problems, may be detrimental to the others. In specific, beta blockers and thiazide diuretics may have adverse effects on the diabetes and lipid control. The database was used to generate a list of patients with diabetes who were on one of these classes of drugs as well as the physician most responsible for their care. Individual memos were generated to the practitioners alerting them to the possible adverse effects. Nine months later, the database was re-examined to look for changes in provider behavior. The results were very positive.

Appropriate Use of Stool Occult Blood Testing. A commonly accepted, useful cancer screening tool is yearly fecal occult blood screening (FOBS) for men and women over 50 years of age. The computer database was queried for the number of patients eligible for FOBS, those who had it done and whether or not it was (a) appropriately logged by the provider on the health screening database or (b) marked by the provider on the billing sheet or (c) both logged and billed. These results were less positive.

RESULTS

User acceptance as indicated by proper updating of the database update worksheets (Mini Electronic Medical Record) increased from 8% to 88% over a two-year period.

Possible Adverse Medication Effects

Two hundred and thirty patients were identified who carried the diagnosis of diabetes mellitus and were either on a beta blocker and/or a thiazide diuretic. Changes in provider prescribing habits were evaluated for a period up to 9 months after memos were sent identifying these patients and their medications.

Eighty patients (34.8%) were excluded, either because the incorrect provider was identified (n=23), the patient left the practice (n=40) or died (n=12), the patient was not actually on a medication in question (n=2), or database information was not available (n=3). The last two categories of exclusion indicate either an inaccurate or incomplete database, and is a surprisingly low percentage (6.3%).

Of the remaining 150 patients, the health care provider made no change in medications over a 9 month period in 50 patients (33.3%). Physician behavior was either changed or considered but justifiably unchanged in 100

patients (66.7%). Forty percent (n=60) discontinued the questionable medications entirely or chose better alternatives.

In the other 26.7% (n=40), a medication change was not indicated. Twenty-five patients (16.7%) had a diagnosis, such as a cardiac arrhythmia, that necessitated the use of the prescribed medication regardless of its effect on diabetes. This was determined by examining the problem list on the Mini Electronic Medical Record.

The remaining 15 patients (10%) were not changed either because the patient refused (n=4), mild hypertension justified only a diuretic (n=7), recalcitrant hypertension necessitated multiple drugs (n=3), or diabetic control and lipid profiles were good in spite of the potentially adverse medications (n=1). This information was obtained through written comments on memos that were returned to the investigator. While no change in prescribing behavior occurred in this group, the response indicates well thought out and appropriate clinical judgement (Table 1).

Table 1

Possible Adverse Medication Reminders	
NO ACTION CONSIDERED	33.3% (n=50)
ACTION CONSIDERED	66.7% (n=100)
Medication Changed	40.0% (n= 60)
Reason for No Change	16.7% (n= 25)
Mild HTN Only - on Diuretic	4.6% (n= 7)
Patient Refused	2.7% (n= 4)
Refractory HTN - Multiple Rx	2.0% (n= 3)
Diabetes/Lipids unaffected	0.7% (n= 1)

Since the health care provider acted as their own control, statistical evaluation of this data is not particularly useful. However, a beneficial prescribing behavior change or rational justification for no change in two-thirds of the participants would seem to be a positive result. No direct chart review was needed, but this might be a useful study to further verify the accuracy of the databases.

Appropriate Use of Stool Occult Blood Testing

During an 18 month period, 530 health maintenance visits by men and women over 50 years of age were recovered from the database. In 34.5% (n=183), fecal occult blood screening (FOBS) was neither logged onto the Mini Electronic Medical Record (MEMR) worksheet nor marked on the fee sheet for billing.

Of the 65.5% of patients who appropriately received FOBS, only 27.4% (n=145) were both logged on the MEMR and marked for billing. Failure to update the MEMR but appropriate billing occurred in 22.4% (n=119), and proper MEMR logging but failure to bill happened in 15.7% (n=83). The former statistic suggests that while a high percentage (88%) of MEMR worksheets are filled out and returned, a significant number may not be accurately completed. The latter number represents a minor loss of income of approximately \$400 over an 18 month period (Table 2).

Table 2

Fecal Occult Blood Screening (n=530)	
NOT LOGGED OR BILLED	34.5% (n=183)
APPROPRIATE SCREENING	65.5% (n=347)
Logged and Billed	27.4% (n=145)
Not Logged but Billed	22.4% (n=119)
Logged but Not Billed	15.7% (n= 83)

The overall results suggest that (1) an inappropriately high percentage of patients are overlooked when it comes to fecal occult blood screening, (2) the database *may* have an undesirable rate of inaccuracies or missing information, and (3) a loss of income is occurring due to inattentiveness. The ability to identify this information, however, is useful with regards to improving patient care and cost-effective clinical operation. Global or individual reminders could be sent to see if improved utilization and billing takes place.

CONCLUSION

The transfer of basic billing information from a proprietary mainframe system into a local, open-ended relational database system has allowed us to begin to address patient care issues and outcomes research that

was previously impossible. The system is relatively inexpensive, flexible, easy to modify and retrieve information from, and requires a minimum of data entry time.

This system has already allowed us to look at prevention, intervention, health promotion, and other issues that are part of the current health care reform. Since outcome measures are not yet well defined, either at the federal level or within managed care systems,¹ and physicians are not yet fluent in incorporating outcomes probabilities into daily practice,^{5,6} an adaptable system, such as we have developed, is ideal for meeting the expected changes in the way we must practice medicine.

The capabilities of this fairly simple as well as time and personnel efficient system are many. The ability to utilize electronically stored information is perhaps limited only by imagination.

Possible future investigations and enhancements include:

- identification of excessive users of medical resources for possible unrecognized behavioral disorders. Besides helping these patients, a financial drain on the health care system could be curtailed by addressing previously unknown problems. This project is currently underway in our department.
- conversion of the passive health screening reminder system into an active system where patients as well as physicians are notified of needed preventive services. This would allow patients to become more responsible for their own well-being and has been shown to be effective in wellness promotion.⁷
- incorporating management plans, such as practice protocols and Stepped Diabetes Management into the health screening database. By use of patient demographics and problem lists, such protocols could automatically triggered by the system. We are currently applying for funding for joining our database with the diabetic Humabase™ software system and Stepped Diabetes Management.
- easy and timely identification of patients for medication recalls.
- an automatic adverse medication interaction system that can be quickly upgraded as new information is released.

- automatic prescription printing requiring only a physician signature.
- remote system access from home while on-call. Of course, appropriate security measures would have to be created in this case.
- transcribed clinic notes could be added to the system for viewing when the paper chart is not available.

There are pitfalls. Inaccurate and incomplete database information could be detrimental to patient care. There are so many ways to code the same diagnosis within the ICD9 system that significant lapses and confusion in the database and retrieval efforts could occur.

In spite of this, we feel that our system has already proven its usefulness, and its future potential is significant. Computerized Health Maintenance reminder systems have already shown their worth.⁸ Any physician's office, with a minimum of resources could use this or a similar open-ended system to track effectiveness of medical practice, improve patient care, and address future quality improvement requirements.

References

1. Greenfield S and Nelson EL. Recent developments and future issues in the use of health status assessment measures in clinical settings. *Med Care*. May 1992; 30(5 Suppl):MS23-41.
2. Litzelman DK et al. Requiring physicians to respond to computerized reminders improves their compliance with preventive care protocols. *J Gen Intern Med*. 1993; 8:311-17.
3. McDonald CJ, Hui SL and Tierney WM. Effects of computer reminders for influenza vaccination on morbidity during influenza epidemics. *MD Comput*. Sep-Oct 1992; 9(5):304-12.
4. West Virginia rural community health information network requirements document. NASA, Marshall Space Flight Center Information Systems Office. November 23, 1994.
5. Eisenberg JM. Doctors' decisions and the cost of medical care. Ann Arbor, Mich. Health Administration Press. 1986.
6. Edelman-Lewis B. Conducting outcomes studies in managed care using a research approach. *JCOM*. Dec 1994; 1(2):65-68.
7. Redland AR and Stuijbergen AK. Strategies for maintenance of health-promotion behaviors. *Nurs Clin North Amer*. Jun 1993; 28(2):427-42.
8. Frame PS, Zimmer JG, Werth PL, Hall WJ and Eberly SW. Computer-based vs manual health maintenance tracking. A controlled trial. *Arch Fam Med*. Jul 1994; 3(7):581-588.